

CLEAN VERSION WITH CHANGES INCORPORATED

IN THE SPECIFICATION

Paragraph beginning at page 3, line 11, has been replaced with the following rewritten paragraph:

81 -- FIG. 12 shows an example of the conditional probability density functions (i.e. "pdf") for the different transmitted messages t1-t4. The probability density functions for each message do not end at the boundaries between messages t1-t4, rather the pdfs overlap. The overlapping of the pdfs gives rise to errors in the minimum distance decoding receiver of FIG. 11. In particular, a receiver can decide that message t3 was transmitted when message t4 was actually transmitted. These errors in the minimum distance decoding receiver can arise because current models assume that noise in the channel is independent of signal strength.--

Paragraph beginning at page 4, line 15, has been replaced with the following rewritten paragraph:

82 -- The invention also provides for a method of identifying a message based upon a received signal. The method includes steps of receiving the signal, generating thresholds, and identifying the message by comparing the received signal with the generated thresholds. The generated thresholds include a minimum threshold and a maximum threshold that represent a variable range for each of a plurality of possible message levels.--

Paragraph beginning at page 6, line 13, has been replaced with the following rewritten paragraph:

83 -- With further reference to FIG. 1, the processor 12 receives signal Y as an input and generates the threshold signals. Further details on generation of the constellation design and the threshold signals are described hereinafter. The threshold signals are received by comparator 14. Comparator 14 then determines, based upon the threshold signals and the received signal Y, the best estimate for the transmitted signal t(i). For example, comparator 14 identifies where the received signal Y lies along the x-axis of Figure 6, relative to the decision regions t1-t4. Once a decision region is identified, the comparator outputs the signal M based upon the decision region identified. Signal M represents the receiver's best estimate for the transmitted signal.--

Paragraph beginning at page 6, line 22, has been replaced with the following rewritten paragraph:

84 -- Processor 12 and comparator 14 can both be formed using electronic circuitry, software instructions executed on a processor, or a combination of circuitry and software. In another aspect of the invention, processor 12 and comparator 14 can be an integral processing block. Particularly, the functions of processor 12 and comparator 14 can be performed by a digital signal processor or micro-processor executing software instructions.--

Paragraph beginning at page 7, line 5, has been replaced with the following rewritten paragraph:

85 -- FIG. 2 shows a block diagram of a new communication system 20 incorporating the receiver 10 of FIG. 1. In comparison, a block diagram of a known communication system is illustrated in FIG. 9. The prior art communication system assumes that noise is independent from the transmitted signal. However, the inventors have discovered that noise is not independent from signal, rather some noise is interrelated with the signal strength being transmitted. From this it follows that different signal levels have different noise properties. This concept is illustrated in FIG. 2. --

Paragraph beginning at page 7, line 12, has been replaced with the following rewritten paragraph:

A-6
-- In particular, communication system 20 includes a transmitter 22, a digital impairment block 24, a first summer 26, a coherent noise block 28, a second summer 30, an independent noise block 32, and the receiver 10. The digital impairment block receives the transmitted signal $t(i)$ from the transmitter 22. The first summer 26, then sums the output signal $s1(i)$ from the digital impairment block with the output c from the coherent noise block, to form the signal $s(i)$. The second summer then sums the signal $s(i)$ with the output signal n from the independent noise block 32, to generate the signal Y . The receiver 10 generates the output signal M in response to the received signal Y .--

Paragraph beginning at page 7, line 20, has been replaced with the following rewritten paragraph:

A-7
-- The inventor's research demonstrated that the digital impairment block 24 is a non-linear re-mapping that is dependent on the transmitted signal level. Coherent noise block 28 is typically Gaussian random noise caused by the CODEC operation or quantization of the transmitted signal $t(i)$. The inventor's research has also shown that the coherent noise block has a variance that is dependent upon the transmitted signal level $t(i)$. Accordingly, the received signal Y is a random Gaussian process that is dependent upon the transmitted signal level. Since the received signal Y is a random process, the received signal is not a deterministic function as conventional channel modeling teaches.--

Paragraph beginning at page 8, line 6, has been replaced with the following rewritten paragraph:

A-8
-- FIG. 3 is an exemplary bar chart showing the distribution function of the received data Y of FIG. 2. The left side of FIG. 3 shows four different transmitted signals, the right side of FIG. 3 shows four different received signals, and a channel is illustrated between the transmitted and received signals. The figure illustrates that the received signal is not deterministic data. Rather, the received signal Y is random data with a particular distribution function. The distance between signal levels, identified as $d1$, $d2$ and $d3$, also varies. Accordingly, a probability function is preferably used to express the event that the received signal equals a particular message level, and a probabilistic function is preferably used to express the distance between message levels. In comparison, as shown in FIG. 10, conventional channel modeling teaches that the received signal levels and the distance between signal levels are deterministic. Conventional channel modeling does not teach that the received signal level is best represented by a range of values and that the range of values for each particular signal level may vary.--

Paragraph beginning at page 8, line 19, has been replaced with the following rewritten paragraph:

A-9
-- FIG. 4 shows an exemplary probability density function for Y as utilized by the receiver 10 of FIG. 1. FIG. 4 illustrates that the received signal Y is randomly distributed data. The received signal data is divided into two curves, one labeled $f_Y[y(k)/t(i)]$ and another labeled $f_Y[y(k)/t(i+1)]$. The curve labeled $f_Y[y(k)/t(i)]$ represents the probability that message $y(k)$ was received given that $t(i)$ was transmitted, and the curve labeled $f_Y[y(k)/t(i+1)]$ represents the probability that message $y(k)$ was received given that $t(i+1)$ was transmitted.--

Paragraph beginning at page 12, line 3, has been replaced with the following rewritten paragraph:

A-10 Conf
-- FIG. 7 is a flow chart for generating a constellation design having a selected number of (i) message levels. The generated constellation design is used by the receiver 10 to identify a transmitted message based upon a received signal. The illustrated flow chart includes the steps of: determining the minimum and the maximum thresholds for each possible received signal level $y(k)$ (Step 86); and calculating the distance $d(i)$ between received signal levels based upon the determined minimum and